

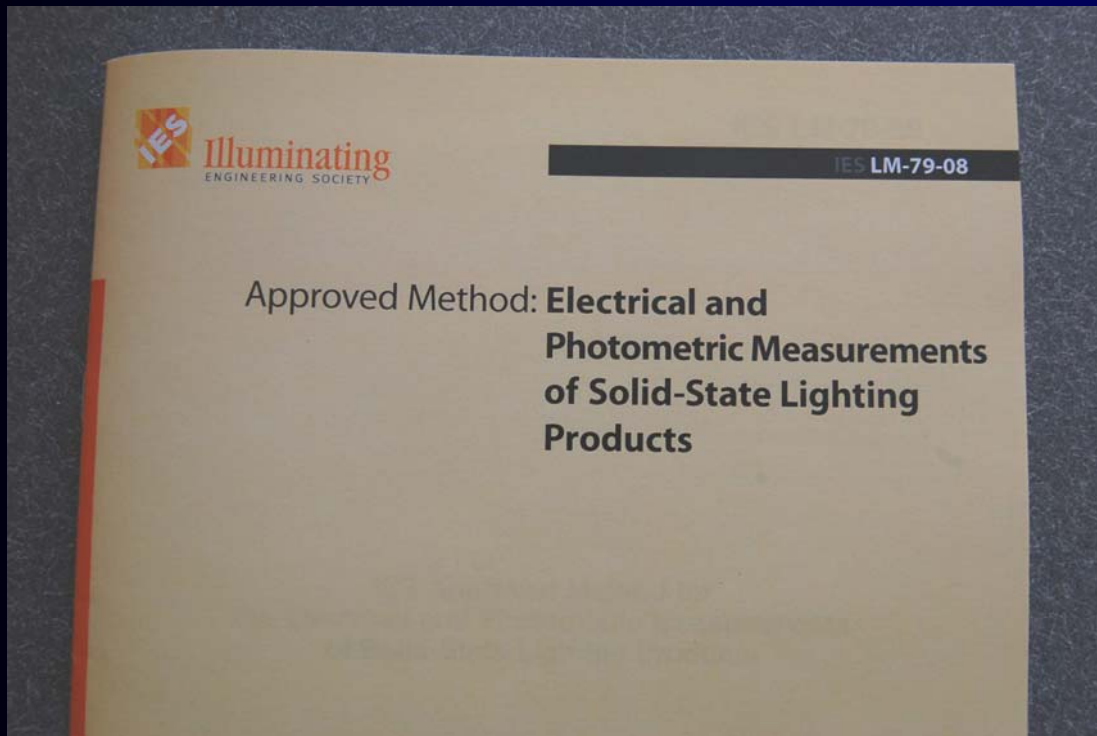
Testing Procedures for Solid State Lighting Products

DOE SSL Market Introduction Workshop
July 9-11, 2008

Status of SSL Testing Procedures

- ANSI C78.377 - Specifications for the Chromaticity of Solid State Lighting Products Published February 2008
- IES LM-79-08 - Electrical and Photometric Measurements of Solid-State Lighting Products Published May 2008
- IES LM-80 - Method for Measuring Lumen Maintenance for SSL Light Sources Expected Summer 2008

Testing to IES LM-79-08



- Goniophotometry
- Integrating Sphere (Photometry and Spectrometry)

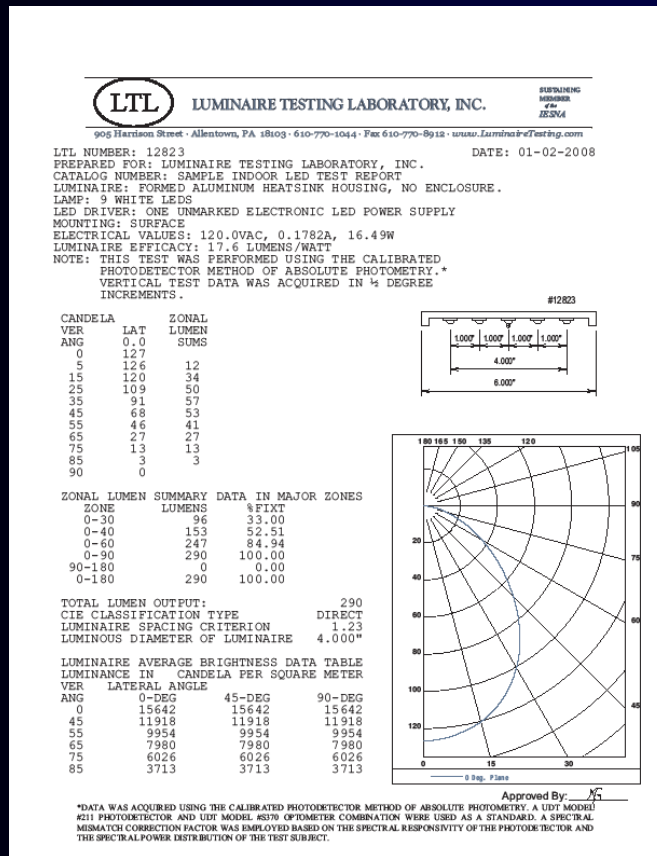
Goniophotometry - LM-79-08



- Absolute Photometry
- Type C Goniophotometer
- Color-Corrected Detector

Goniophotometry LM-79-08

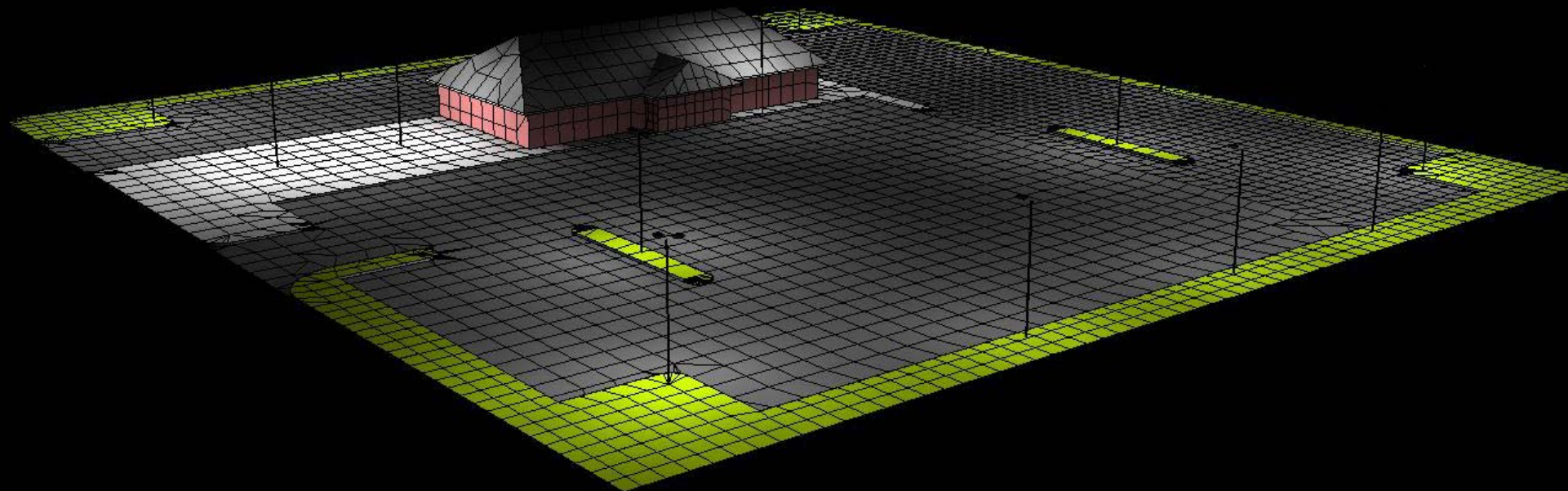
- Luminous Intensity Distribution
- Total Luminous Flux
- Zonal Lumen Sums
- IES Format File



Goniophotometry LM-79-08

The results can be used to predict the performance of the luminaire in its application.

- IES Format Files
- Illuminance (Footcandles, Lux)
- Average footcandles within a space, max/min ratios, etc.



Relative Photometry

Luminaires that use conventional lighting sources are usually tested using relative photometry.

- The luminaire is measured.
- The lamp(s) and ballast(s) are removed and measured.
- Luminaire Efficiency can then be calculated
- The luminous intensity distribution is scaled to candela per rated lumen.

Relative vs. Absolute Photometry

Relative

- Typically performed for luminaires using conventional sources
- Luminaire test is referenced to the luminous flux measured from the “bare” lamp(s)
- cd per rated lumens
- Normalizes ballast factor, lamp age
- Includes luminaire efficiency

Absolute

- Luminaire test is referenced to a calibrated standard lamp
- Absolute luminous intensity (cd)
- No luminaire efficiency
- Total luminous flux (lumens)
- Used to calculate absolute luminaire efficacy (lumens per watt)

Relative Photometry

A quick example: 2-lamp 26W downlight

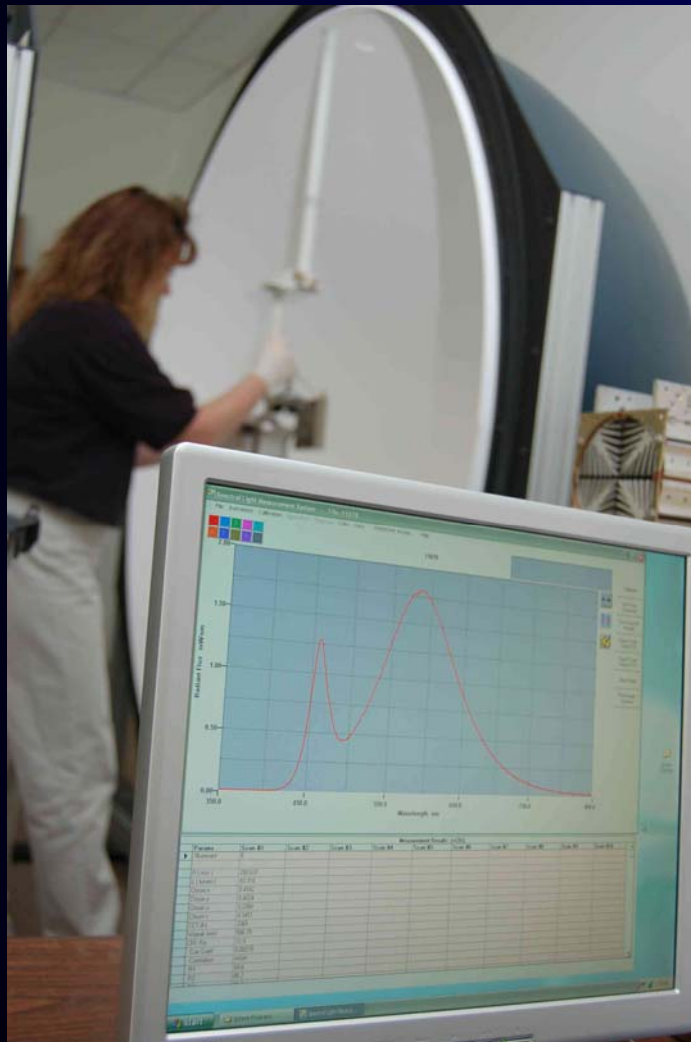
- Lamp Efficacy: $1800 \text{ lm} / 26\text{W} = 69 \text{ lumens} / \text{Watt}$
- Luminaire Input Watts = 54W
- $2 * 1800 \text{ lumens} = 3600 \text{ lumens}$
- Apply Ballast Factor: $3600 * 0.9 = 3240 \text{ lumens}$
- Apply Luminaire Efficiency: $3240 * 0.6 = 1944$
- Divide by Input Watts: $1944 / 54 = 36 \text{ lumens} / \text{Watt}$
- Calculated Luminaire Efficacy: $36 \text{ lumens} / \text{Watt}$

Goniophotometry LM-79-08

LM-79 does not specify the format of the photometric test reports.

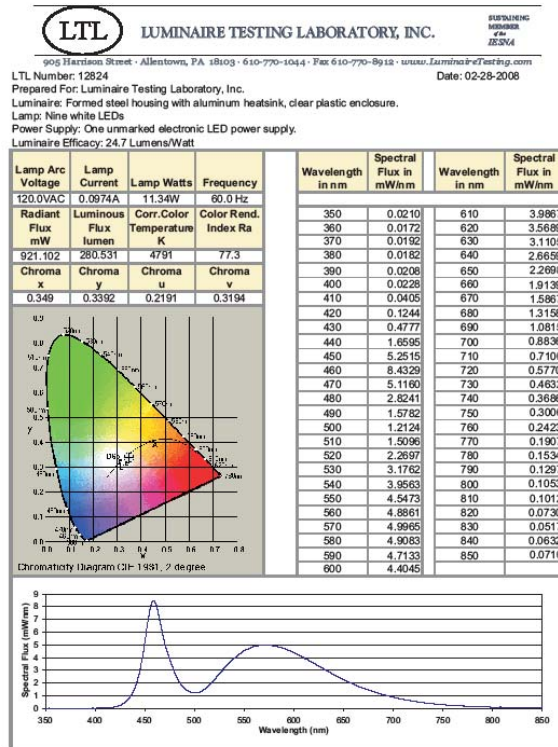
- Indoor (LM-41, LM-46)
- Roadway (LM-31, LM-10)
- Floodlight (LM-35)

Integrating Sphere LM-79-08



- Photometry
- Spectrometry
- Self-absorption
- Size Limitations

Integrating Sphere LM-79-08



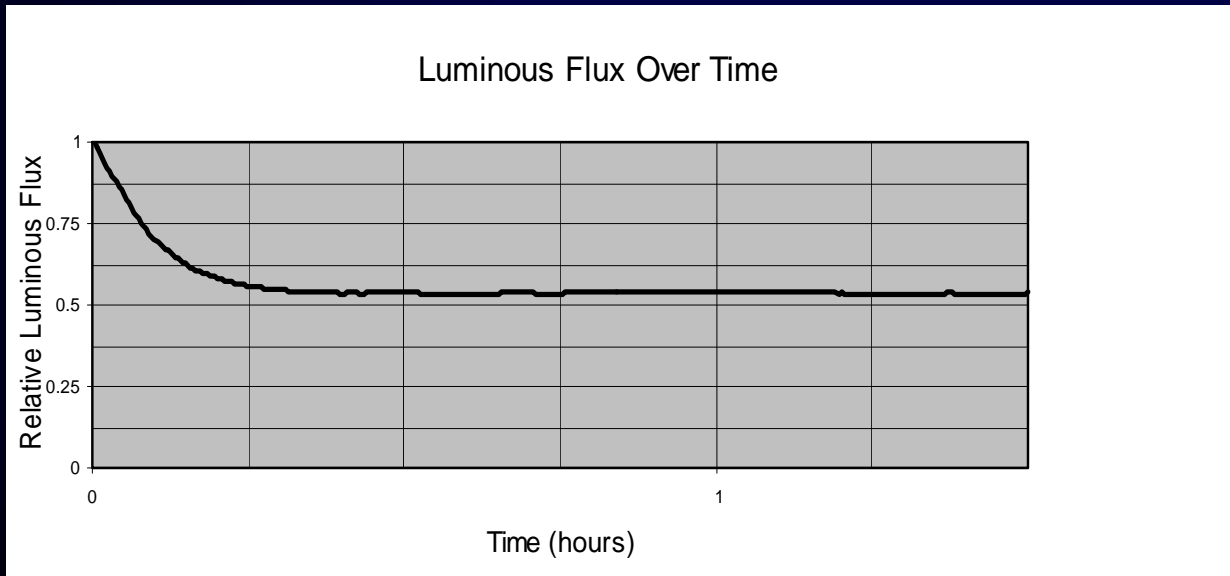
- Total Luminous Flux
- Spectral Power Distribution
- Chromaticity Coordinates
- CRI
- CCT

Electrical Measurements

- Input Voltage (*RMS or DC Volts*)
- Input Current (*RMS or DC Amps*)
- Luminaire Power (*RMS or DC Watts*)
- Power Factor (*note: $P = I_{RMS} * V_{RMS} * PF$*)
- Measurements are made after stabilization is reached.
- Note that stabilization in LM-79 is defined by the photometric readings and electrical power readings.

How Long Does a Test Take?

- Goniophotometry
- Integrating Sphere
- Stabilization Time is the bottleneck.
Preburning can help if done properly.



What aspects of SSL performance will these test procedures measure?

- Total Luminous Flux
- Luminaire Input Electrical Power
- Total Luminaire Efficacy (lumens per watt)
- Spectral Power Distribution
- Chromaticity Coordinates (x, y and u', v')
- CRI (Color Rendering Index)
- CCT (Correlated Color Temperature)
- Spatial Uniformity of Color ($\Delta u', v'$)
- Luminous Intensity Distribution
- Zonal Lumen Sums
- Lumen Maintenance (L_{50} and L_{70})

Testing Procedures for Solid State Lighting Products

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